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# The ancestry of maize—a reply to criticism

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In a recent article by H. J. Kempton (1), of the Bureau of Plant Industry, exception is taken to some statements made by me in a paper appearing last September in the Bulletin of the Torrey Botanical Club (45: 309–342), on the evolution of maize. Inasmuch as some real errors are pointed out in this criticism, their correction is in order; but, as to certain other points upon which our data differ, I have nothing to add to my original paper. Our differences of opinion on matters of interpretation and evaluation of facts would probably not be diminished by further discussion; and any criticism on ethical grounds of the spirit of Kempton's paper and his imputations of the writer's ignorance are left to the fair judgment of the reader. But Kempton's manner of treating details and his intermingling of the irrelevant with the relevant have clouded the issue, and a brief presentation of its present status seems appropriate.

It is said (p. 4) that I have misrepresented Collins (2) by confusing bracts with prophylla and by substituting "one-rowed" for "single-rowed" in a quotation. Both points are well taken, for no misrepresentation was intended. These errors had been discovered long before the appearance of Kempton's paper, and steps had already been taken to correct them; this is a welcome opportunity to do so.

The error in speaking of the husk of the maize ear as prophylla (pp. 314, 330) does involve an unintentional misrepresentation of Collins's statement; but this point is beside the question, for the true prophylla of all kinds of maize, including pod corn, have buds in their axils, which is the significant point. Whether or not these buds develop far enough to be visible externally is a quantitative matter. The difference between "one" and "single" in the quotation (p. 321), describing the pistillate spike of teosinte, is appreciated, and it is unfortunate that the substitution was made. But the bearing of this point upon the evolution of the ear is unchanged, for the fact remains that Collins (p. 525, footnote) was using the structure of the spike of teosinte in an attempt to explain the appearance of ears with odd numbers of rows in some hybrids between maize and teosinte; and a "single-rowed" spike, such as that of teosinte, is of no avail in getting around the difficulty, for it has *two* rows of functional spikelets, not to mention the aborted ones.

Kempton's support (pp. 6–7) of the theory that the ear of maize originated by fasciation is based chiefly upon certain true-breeding races having bifurcated ears and a bifurcated central spike in the tassel. But our only evidence of the regressive nature of these mutants is the fasciation theory itself, and reasoning of this kind does not make much progress. The fact that ears having rows not in multiples of four could not have been formed by the union of spikes having four rows each is evaded by Kempton's assumption (p. 7) that a row of pairs of spikelets or the pedicelled spikelets of two such rows were aborted. Abortion of parts is a common occurrence in maize, but our best evidence of this is in finding their rudiments; and, if abortion is thought to be responsible for the occurrence of ears with ten, fourteen, or eighteen rows, the burden of proof is with those who reject a more simple and more direct explanation of the situation. Such an explanation is afforded by the theory that the ear and the central spike of the tassel have developed from a branched inflorescence like that of some of the sorghums. The assumption here involved is that the pairs of spikelets are the remnants of reduced branches; and material illustrative of intermediate steps in this reduction is afforded by branch corn, which was unknown when Collins (p. 526) rejected this theory.

Advocates of the hypothesis that maize arose by hybridization find the necessity for their position in the fact that ordinary maize has so many primitive characteristics and seems to occupy an intermediate position between teosinte, which is more highly specialized, and pod corn, which seems to be more primitive than ordinary maize.

A detailed morphological study shows that the differences in specialization here concerned are neither so great nor so significant as was supposed when the hypothesis was first advanced; but further discussion of this point is waived for the present.

The primitive characters of the maize plant might cause some difficulty in connection with any theory to the effect that maize descended from teosinte itself or from some plant much like teosinte; but probably no one at present gives serious consideration to any such theory. In descending directly from a primitive ancestor, the plant need not have made equal progress in all respects, and a combination of highly specialized characters with others relatively simple would be expected. Probably no one appreciates more fully than does the systematist the significance of this principle.

The weakest spot in the hypothesis of the hybrid origin of *Zea* lies in the fact that pod corn has not been shown to be essentially different from ordinary corn except in the possession of enlarged bracts and of functional pistils in the tassel. In Collins's argument, pod corn has no exact identity. Sometimes it has ears, and sometimes it is earless. He seems to have selected from all the characteristics possessed by this ill-defined variety those tending to uphold his hypothesis. Kempton admits as much (p. 7) when he attributes the presence of buds in the axils of the leaves of pod corn to the recent origin of this variety from ordinary corn. The problem for which they offer no solution involves a means of distinguishing the characters of the orthodox podded type—one of the hypothetical ancestors of *Zea*, according to their view—from other characters received from ordinary maize by this recent mutant. It is true that the hybrid-origin hypothesis itself will distinguish them, but, when we apply it, we find ourselves dealing in circular logic. It is generally admitted that the podded types now in existence are recent mutations rather than original forms; but our criterion for the regressive nature of some of their characteristics is in the character of the grasses held to be closely related to maize.

The idea of the hybrid origin of maize has had the misfortune to be based upon a hypothesis not substantiated by subsequently discovered facts. It has never been very enthusaistically accepted by botanists in general, because it seems unreasonable and taxes the imagination unnecessarily. It has had its good effect in promoting further investigation, but it has run its course and has been found wanting.

On the other hand, comparative morphology, which has been one of the most reliable and productive agents in establishing lasting theories of evolution, points out clear-cut, logical, reasonable evidence of the direct origin of *Zea*, coördinately with *Euchlaena* and *Tripsacum*, from an ancestor long ago extinct. There has been pointed out no accepted fact whose rational interpretation discloses any inconsistency in the theory. The three genera are different simply because they have lost different organs that were possessed by their progenitor and have specialized others to different degrees.

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## LITERATURE CITED

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2. **Collins, G. N.** The origin of maize. Jour. Wash. Acad. Sci. **2**: 520–530. 1912.